The Role of Models in Relativity Theory and Experiment

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New Intuitions - A perhaps simplistic view of science is that it is concerned with developing very general theories about the nature of matter, space and time, which are modified & controlled by experiments. On a Popperian view, the theories are proposed as conjectures, and the role of experiment is to falsify these conjectures, according to certain rational procedures. I take for granted in this paper that such refutations are not logically foolproof, that theories can always be protected by conventionalist strategems, as Popper calls them, but I don't need such Popperian detail to discuss the choice of what theories to entertain and work on, to accept, provisionally and not in the sense of 'believing' to be the final truth, is not an arbitrary matter, to be confused in methodological jargon, with psychological or sociological terms, I do not deny the role of such external factors in governing what a scientist rationally does, but I believe that rationality in science can do better than merely describe scientific practice, that there is a normative internal logic of scientific procedure.

However, in this paper I do want to look at some actual scientific practice ~~to see whether~~ viz. the use of models to see whether these uses can be logically justified, or just at what point, if ever, model-based intuitive considerations enter into the discussion.

How then do models relate theory and experiment?

The basic puzzle is that ~~theory~~ produced theories are in general much too complicated to from that their observational consequences are at all! So how can experiments ever be bearing on such theories?

The role of models in such a situation is 3-fold:

(1) we can use models to suggest ways in which theories actually have from the mathematical point of view. This role, I will refer to as the fleshing of theories.

(2) If a model has some property of which we really do not know whether the theory has that property or not, then we can devise a (possibly new theory by simply fleshing both this property as a new axiom. This role I will refer to as the heuristic role of models

(3) Finally we may use the model as a substitute for the theory and compare its empirical predictions with experiment. This role I will refer to as the testing of theories.

But first I must explain what is meant by the term model and make the basic distinction between theoretical models and analogue models